SCIENCE

NEW YORK, JUNE 12, 1891.

RECENT EXPERIMENTS IN AUTOMATIC WRITING.[1]

IT is well to state, at the outset of this paper, that it will not be found to contain anything new or startling. Nor does it seem to me that these characteristics are necessary to its usefulness. For though such features have a value of their own in stimulating inquiry, and in forming matter for assimilation by future investigators who shall have ascertained the principles or laws which, in our present state of knowledge, we are only groping after, they at present rather confound than assist our reason. On the other hand, the more we gain in experimental acquaintance with the psychical side of existence in the living subject, the more likely of fruition, because the more easy of classification, will be those rare and sporadic phenomena which may be gleaned from the world of phantasm and of second sight.

While, therefore, facts of all kinds are valuable to us, the most hopeful method of psychical research appears to me to proceed from the known to the unknown, and from the simple to the complex, and thus, by studying the grammar of research, to find gradually the meaning of fact after fact which at present convey no more significance to us than so many undeciphered hieroglyphics.

To no person are we more indebted for showing us this path to the knowledge which we seek than to Edmund Gurney, whose experiments in hypnotism have thrown a new light upon the constitution of human personality in the living man, and my desire, in the kind of experiments I am about to record, is to follow humbly in his footsteps.

In comparing hypnotic experiment with automatic writing, we find both advantage and disadvantage. The advantages of hypnotism are, the opportunities for studying physiological as well as psychical phenomena, the absolute control which it gives us over the subject, unchecked by his self-consciousness, fear of ridicule, and the like, and the greater security from conscious reception or prejudiced ideas which it assures us of as long as hypnosis lasts. On the other hand, granting the good faith of the automatic writer, we can obtain nearly as full results on the psychical side, without risk, or the imputation of risk, to the moral or physical well-being of the operator, and can pursue the inquiry at any spare moment and with no further appliances than a pencil and a sheet of paper.

One thing, however, is essential, and that is an unprejudiced mind. In automatic writing we are confronted at once with a mysterious intelligent agency, operating without the conscious will or mental participation of the writer, but subject, as I am inclined to think, to suggestion in the highest degree. Let it be impressed upon the mind of the writer that this seemingly extraneous intelligence is extramundane also, and it will respond to his ideas with the utmost fidelity. Let him believe that he is holding intercourse with Satan, and it will hasten to assure him of the fact, and back up the assertion with profane language; or let him believe himself in communication with some other spirit, celestial or terrestrial, and to the utmost of his own knowledge, possessed or forgotten, will he be humored to the top of his bent. In all this we see just what might be expected from our knowledge, already acquired, of the workings of the passive consciousness. Like clay in the hands of the potter (this simile is appropriate in this particular connection, but it would be far otherwise in a general description of the passive personality), the passive consciousness of the hypnotized subject accepts the part assigned him, and he is equally ready to believe himself a brooding hen or a water pump, and to spread his arms for wings or work them up and down for handles. In relating the few facts which I am about to describe, my principal object is, however, not to sustain or assail any theories, but to stimulate inquiry. My hope is that many persons may be induced to make experiments who at present hold aloof from fear of meddling with what is forbidden, or uncanny, or too serious for what they would deem trifling. In the journal for July I appealed for assistance in these experiments, and from all those whom it reaches I only got replies from two gentlemen, neither of whom, unfortunately, could use the planchette. Is there no one, then, among our seven hundred members and associates who has the gift, and can spare fifteen minutes now and then to make experiments and record results?

The operator in the following experiments is a young lady, aged fifteen, an inmate of my household, and companion in study with my own daughter. We have, therefore, the best means of estimating her character and her *bona fides*, which, let me say at once, are, we consider, beyond a doubt. She had not previously heard of planchette, and Spiritualism was, to her, a mere name. I took care from the first that no ideas of this kind should be instilled, and she thus approached the subject without any foregone conclusion. Most of the experiments were made with the aid of a planchette. But latterly a pencil was used, held vertically between the points of the fingers and thumbs of both hands, and once or twice the pencil was held in the ordinary way. These changes, however, did not seem to affect the result. The first experiments were attempted by this girl, whom I will call C., in conjunction with her companion, but it soon became evident that the latter was merely a passenger, so to speak, and that C. was the real operator. She was therefore left to write by herself. Unfortunately she looked upon the whole thing as a great bore, and, as I was unwilling to press her, the experiments have only been few and far between. She never knew what she had written till it was looked at, and there was often some slight difficulty in deciphering it.

Thus the first question, Who are you that write? produced what at first I took to be mere scrawling, and C. shortly after left the room. After she had done so I took another look at this scrawl, and then at once perceived that it was legible, and that the name written in answer to the question was "Henry Morton." I at once followed C. upstairs, and asked her if she had ever heard the name, and she replied that it was that of a character in a Christmas play she had acted in, more than a year previously. Had the name, as

[1] Abstract of a paper by Thomas Barkworth in the Proceedings of the Society for Psychical Research, April, 1891.

it easily might have, been that of some deceased friend, it is obvious what inference would have been drawn. I give the next three questions just in the order they followed on the next evening. (2) Why do you write? — A. Because I must. (3) What compels you to write? — A. I do not know. (4) Henry Morton, do you know you are a part of me? — A. Yes, I know.

The last question, being asked in a tone of conviction, amounted to a suggestion, and was adopted accordingly. This docility was illustrated in other ways. For instance, the planchette, having taken to running straight off the paper after completing an answer, was told not to do so again, and at once complied. I should here say that all the questions and instructions to the planchette were first dictated by me and then repeated aloud by the operator.

Some spelling tests followed. C. is not good at spelling, and feels great uncertainty with difficult words. Her voluntary spelling of such is very hesitating, and does not therefore give any suggestion to the passive consciousness. The two personalities acted, therefore, independently of one another, with some curious results. I will give one instance. (7) Spell psychical.

A voluntary attempt was first made. Result: "Sicickle." C. was not told whether this was right or wrong, but was told to try planchette. Result: "Cicicle."

Some questions in mental arithmetic were put, the planchette being instructed to write the answers only, without any calculation. I am informed by her governess that C. has but little arithmetical capability, and is backward for her age in this subject. Bearing this in mind, I think the results were noteworthy. Directly the question was put the instrument began to write the answer. (28) Divide 264 by 16.

First of all an attempt was made to work the sum voluntarily, and, with some delay, the answer given was "17 odd," which was wrong, but on planchette being appealed to it at once wrote "16 and 8 over," which was correct. As we had many instances of the passive intelligence thus excelling the primary activities of the mind, I may take this opportunity of saying that it is quite in accordance with what I had expected, and have elsewhere spoken of, but whether this superiority is essential or accidental, whether, that is, it be due to greater power or to greater concentration, cannot at present be determined, at all events evidentially. (12) Divide 187,981 by 13. — Answer, 14,463.

This is wrong by three only, and, considering the normal powers of the operator above-mentioned, I think it a some what remarkable answer.

I now come to a class of questions designed to test the memory of the passive consciousness. "What happened on the 1st of June?" This question was asked in the last week of July. I chose the date at hazard, and neither C. nor I had any recollection of it. But planchette answered "Went to church," and we then got an almanac and found that the 1st of June was a Sunday. This kind of question was often tried with inconclusive results, but never with incorrect ones, except on one occasion. Being asked in October what happened on the 13th of July, the answer was "Monday lessons." If planchette thought the day was Monday, it is rather curious that it should not have said simply "lessons." In reality, however, the day was a Sunday, and it would be not impossible that C. had during that Sunday been worrying herself about the following day's work. The manner in which the word "lessons" was written was a curiosity. After writing "Monday," the tail of the *y* was brought back with elaborate flourishes, and the first *s* in "lessons" was written; then the *e* and the *l* were written backwards; then the pencil was carried forward with more flourishes and gyrations to the second *s*, followed by the other letters in their order. So florid was all this scroll work that it took much care to find afterwards what route the pencil had taken, though the word was entirely legible.

(14) "Who conquered Peru?" The answer to this was written "Spires," and such an answer being unintelligible, planchette was made to repeat it, with the same result. It then occurred to C.'s governess to fetch the volume of Collier's History which C. had been reading three months previously. At the head of one of the chapters was a table of dates which she had (at the time) learnt by heart, among which were the following consecutively: Reformers called Protestants at Spires, 1529; League of Smalcald, 1530; Pizarro conquers Peru, 1533. The name of Pizarro, which C. had forgotten, is placed in print exactly below the word "Spires," and in this way the two words fell together under C.'s eye, and became indelibly associated in what I have elsewhere ventured to call the pictorial memory of the passive consciousness. The next experiments I shall describe exhibit memory in another aspect. (11) Tell me something I don't know. — A. You have a shot in your eye.

On examination, I found a small blood-speck on the margin of the iris of one eye. This C. assured me she had no idea existed. It is probable, however, that she had at some time seen it in her looking-glass when her mind was occupied with other matters.

(17) Tell me something more. — No answer but scrawling. (18) You must write (peremptorily). — A. Frank Headley ill. (I have altered the name.) In answer to inquiries, C. said this was the name of a boy she had met at the seaside two years before, but she knew no more about him, not even where he lived. Accordingly, the next question was, (19) What is Frank Headley's address? — A. Lord Mayor's-walk.

C., who lived near York, thought there was a street of this name there, but was not sure. It was not till she went home for the holidays that she ascertained, through mutual friends, that Frank Headley went to school in Lord Mayor's-walk, so that planchette was found to have answered correctly. The explanation suggested is, that, when he met her two years previously, he had mentioned this and she had forgotten it. Planchette, however, was unable to give the number in Lord Mayor's-walk, which perhaps he had never told her, and when asked what he was ill with, replied "Cold in head."

Some experiments were made with the right and left hands consecutively; thus, (27) Give the name of one of the principal Elizabethan statesmen. (Right hand answer)—Walpole. (Left had answer)—Walsingham.

The last group of questions asked referred to subjects which it was certain C. did not know and never had known. For instance, "What is the price of Egyptian Unified?" "What is the second Christian name of So-and-so?" etc. Invariably these questions produced no reply; the instrument only made scrawls. It may be possible, however, that had an answer been insisted on, one would have been written (as in the case of Frank Headley's alleged cold in the head), and necessarily an incorrect one, because of the writer's ignorance of the facts, combined with the effects of suggestion compelling an answer of some kind. This I am inclined to think may be the explanation of Mrs. Newnham's answers under her husband's cross-examination (Proceedings, III., 7–23;

"Phantasms of the Living," I., 63–71) — answers which he says were foreign to the conscious intelligence of either of them, and which contained an attempt at deliberate invention rather than plead guilty to total ignorance. If, under suggestion, a hypnotic subject were told to jump over a house, he would not be able to do it, but he would jump as high as he could.

Among miscellaneous questions one only is worth recording. It was, "Are you the spirit of my grandmother?" This was the only time the idea of spirits was introduced, and as it was obviously put jestingly, it did not convey any real suggestion of their agency. The answer accordingly was, "No, I was in ———"; and here followed a remarkably well-executed outline map of Africa, such as few persons, and certainly not C., could have drawn from memory; every important bay and promontory being — as we found on comparison with the atlas — correctly shown, and in due proportion. At one point only was it in error.

The explanation was not that C. was guided by some defunct geographer or Africander, but that she had been getting up the geography of Africa that morning with the aid of the map; and thus had the pictorial memory of the passive personality, unconsciously to herself, recorded, and reproduced this complicated observation, which she had made without effort, and which was merely incidental to her task.

Such are the few and slight experiments which I have ventured to lay before the society. I have done so mainly for two reasons; first, the hope that sufficient interest may be aroused in those who hear of them to induce other and more important essays in this interesting method of investigation; and, second, to indicate the lines on which it may, I think, be most profitably pursued. It would seem that nothing is ever really forgotten, though the bygone memories evoked by pencil, or crystal, may appear so new and strange that we fail to recognize them as ever having been included in our experience.

EXTENSION OF UNIVERSITY TEACHING.

THE American Society for the Extension of University Teaching was founded in response to a deeply felt want for a national association which might assist in promoting the work of university extension.

The friends of popular education feel that the time has come for a better utilization of the facilities for instruction which are to be found in our existing educational institutions.

Our common schools, academies, high schools, colleges, and universities offer good opportunities for an education to those who are able to attend them for twelve or fifteen consecutive years. But the persons able to do this in our communities form a very small fraction of the population. The average child can attend school only four, or at most five, full years, — a period barely sufficient to make a beginning in the rudiments of an education. This is a significant fact, and it justifies the statement that the great mass of the community are in large part cut off from any direct participation in the higher branches of science, for the cultivation of which our advanced institutions of learning are organized.

The credit of recognizing this fact in all its significance, and of determining to change it, if possible, is due to the English universities. In order to test whether it were not practicable to utilize the magnificent facilities of the old English centres of learning for the purposes of popular instruction, a movement was organized to which the name of "University Extension" was given, and which involved sending out lecturers and professors from the universities to give courses of instruction at various places throughout the country. The effort was crowned with success, and has attracted universal attention.

Among the first communities to recognize the possibility for such work in the United States was the city of Philadelphia. For the purpose of testing whether there was a general demand for university extension, a call was issued for a meeting of those citizens interested in the movement. As a result, a local society was organized in order to make an experiment in and around Philadelphia. Having assured itself of the co-operation of the professors of the colleges and universities in or near the city, including the University of Pennsylvania, Princeton University, Bryn Mawr, Haverford, Rutgers, and Swarthmore, the society sent its secretary to England to study the movement there and make a report, and submit plans of organization.

The services of Mr. Richard G. Moulton of Cambridge, England, were secured, and, aided by professors from the above institutions, systematic instruction was undertaken at several different points in November, 1890. The success far exceeded all anticipations. Over forty courses of instruction, embracing two hundred and fifty lectures, were given, with an aggregate attendance of over 50,000, thus surpassing all English records. The demand for courses from a distance was so great that it could not be met.

As a consequence of this experience it was determined to establish a national society to aid in the inauguration and prosecution of this great work, and to do, as far as possible, for the country at large, what the local society has done for Philadelphia. The co-operation of a large number of representative institutions was assured from the outset, and the number of institutions committed to the movement is rapidly increasing.

The American society proposes to collect information as to the experiments now going on in this work in the various parts of the world, and make it accessible to all who are interested in this movement. It will, as far as possible, form branch societies to take up and push the work in and around their localities. It will try to secure a staff of persons trained by actual experience in organizing and lecturing, who may be placed at the disposal of the local societies to assist them in organizing and prosecuting the work. It will strive to make every college and university in the country a centre of university extension.

It is confidently believed that university extension will not only aid greatly the progress of popular education by affording vastly increased facilities for study, but will also benefit the colleges and universities by exciting a wide-spread interest in the work.

The association proposes to publish a journal, to be called *University Extension*, which will serve as a medium of communication between the national society and the local branches, and will give full information as to the progress of the work in all parts of the country.

To do this work efficiently will require large funds. The only sources of income at present are the fees of members ($5 annual fee, $50 life-membership fee) and the voluntary contributions of friends of the movement. The membership fee and all other contributions may be sent, payable to the order of Frederick B. Miles, Treasurer of the American Society for the Extension of University Teaching, 1602 Chestnut Street, Philadelphia. All other communications should be sent to the General Secretary, George Henderson, 1602 Chestnut Street.

NOTES AND NEWS.

BEGINNING with the class entering in September, 1892, the regular course necessary to obtain the degree of M.D. at the Harvard Medical School will be four years. A similar change in the course of medical study is proposed at the University of Pennsylvania.

— Mr. James E. Keeler has been appointed director of the Allegheny Observatory, succeeding Mr. S. P. Langley, secretary of the Smithsonian Institution, who recently resigned the directorship of the observatory.

— The Kenwood Physical Observatory, Forty-sixth Street and Drexel Boulevard, Chicago, will be dedicated on Monday evening, June 15, at eight o'clock. Addresses will be delivered by Professor C. A. Young of Princeton, Professor G. W. Hough, and others.

— A special inquiry was made in the census of last year as to the vital statistics of the Jews in this country. Returns were received from 10,618 Jewish families, representing 60,630 persons.

According to the *Sanitary Inspector*, the death-rate obtained from the figures is one third less for males and one-fourth less for females than among the rest of the population. On the other hand, the marriage and birth rates are low.

— A singlar case of spontaneous combustion is reported, where a painter engaged in a mill removed his overalls at 6 P.M. to go home. At half-past eight the watchman, discovering smoke in the mill, summoned the engineer, and together they searched the premises carefully, tracing the smoke to a small room in which the overalls were discovered, and in one pocket was a bunch of greasy waste that had ignited, showing, says *Architecture and Building*, that spontaneous combustion may ensue in less than three hours if the conditions are favorable.

— It is proposed to hold in the club-room of the Appalachian Mountain Club, Boston, next autumn, an exhibition of botanical specimens, given or loaned for the purpose by members of the club or their friends. All persons who are willing to aid in this matter, whether botanists or not, are requested to communicate with the councillor of natural history of the club, or with Mr. Walter R. Davis of the excursion committee. It is hoped that many specimens may be obtained during the summer, especially of plants distinctly Alpine in habit.

— Professor S. P. Langley of the Smithsonian Institution announces that there has been established, as a department of the institution, a physical laboratory, which has been furnished with specially designed apparatus for the prosecution of investigations in radiant energy and other departments of telluric and astrophysics. The communication of new memoirs bearing in any way on such researches is requested, and for them it is hoped that proper return can be made in due time. All scientific men will rejoice in these improved facilities for the continuance of Professor Langley's famous investigations.

— Bulletin No. 17 of the Kansas Agricultural Experiment Station gives the results of three years' experiments in the artificial crossing of a large number of varieties of corn. The different races — as dent, flint, soft, sweet, and pop corn — were all crossed with difficulty. The effect of the cross was seldom visible the first year, but the second generation showed very generally ears more or less completely blended, often exactly intermediate between the two parental types. The product of the third year is generally true to the seed planted; that is, by selecting diverse grains from any ears, ears are obtained with grains usually like those planted. Any desired form of a cross can therefore be perpetuated.

— A letter lately received from Emin Pasha by one of his ornithological correspondents in Europe is dated from one of the larger islands on Lake Victoria Nyanza in November last. According to *Nature*, it is full of details about birds, in which, as is well known, the Pasha takes the keenest interest, and alludes especially to an apparently new *Gralline* form, with three toes, met with in that district. Emin was on the point of starting southwards into the territory near the north end of Lake Tanganyika, and is now probably somewhere in that little-known country. He had been joined by Dr. Stuhlman, a young naturalist of Hamburg. Dr. G. Hartlaub of Bremen has just published a memoir on the birds collected by Emin during his return to the coast with the Stanley expedition and his subsequent sojourn at Bagamoyo. The specimens are referred to 140 species, of which eight are described as new to science.

— The curve shown by the graphic daily record of the magnetic declination, or variation of the compass, at Washington during the exceptionally severe magnetic storm that occurred about the middle of May, is of special interest. Beginning at 7 A.M. on the 13th, the magnetic disturbance attained its maximum between 6 and 11 P.M. of the following day, and again between 4 and 10 A.M. of the 15th, not finally ending until the 18th. During this storm the direction of the magnetic needle changed 48′ in 9½ hours. A correspondingly large disturbance was indicated by the instruments registering the horizontal-force component of the earth's magnetism. A marked feature of the storm was an oscillating movement of the north end of the magnetic needle to the eastward, attaining a maximum departure from normal of 35′ on the 14th, between 6 and 11 P.M., accompanied by a large decrease in the horizontal-force and increase in the vertical component. During the afternoon and evening of the 15th the north end of the needle was deflected to the westward, accompanied by a decrease of horizontal force even greater than during the evening of the 14th, and a corresponding decrease in vertical force.

— Serafini and Arata have made some investigations to determine the correctness of the belief that the foliage of trees has some influence in filtering out the bacterial contents of the atmosphere. Their method of procedure, says the *Sanitary Inspector*, was to determine the number of bacteria in air under motion before and after it had reached the woods. The barometrical pressure, direction and strength of the wind, temperature at the edge and in the midst of the woods, humidity and rainfall, were all taken into consideration. As the number of observations was only forty, the investigators give the results with some reserve, nevertheless they believe that they are justified in affirming that forests do exercise the power of straining out the bacteria that are brought to them by the wind.

— Mr. C. Powell Karr, an architect of New York City, has extended his courses of home study in architecture. The instruction is conducted by mail. When these courses were initiated in 1887 they were established to aid young men and women, who, while holding a preference for architecture over its sister arts, have been denied an early opportunity of preparing themselves for their chosen work. At the present time, when so many universities have thoroughly organized and flourishing architectural courses, it would seem almost superfluous to supplement them by such a series of courses, but there is a great advantage in entering the collegiate life well equipped and thoroughly enlightened, and many have availed themselves of this system. It has been found also that there are a limited number of young men and women who are now engaged in pursuits allied to architecture who could and would avail themselves of these courses, and for them especially the revision has been made, the courses expanded and made individually applicable to the advancement of their professional and business interests. Among the students are found carpenters, masons, builders, contractors, professional draughtsmen, architects' superintendents, and even practising architects themselves. Architects have been quick to respond to the advantages offered them by the course in architectural engineering, as they feel the necessity of being in touch with the practice of the profession in the metropolis, and of having a living reference upon questions of difficult construction or technical procedure that may arise at a moment's notice.

— The evil repute of the cat still clings to him, says the *Illustrated American*. A Finisterre cat which has served nine masters in succession is believed to have the right of carrying off the soul of the ninth to hell. In Upper Brittany there are sometimes seen enormous cats engaged in holding a meeting. If any one presumes to intrude upon their presence, they surround and tease him for a time. Then a long needle is driven into his heart and he is dismissed. Hypochondria ensues, and he slowly wastes away. A black tom-cat, says a Russian proverb, at the end of seven years becomes a devil. A Breton farmer, who neglected to take the usual precaution of putting his tom-cat to death before it completed its seventh year, was found dead in bed one morning, with his throat terribly torn. Suspicion fell upon innocent persons, who were likely to be hanged on circumstantial evidence. Luckily, a boy observed that the cat of the house was always watching the corpse with eyes that blazed with rage. So he fastened to the dead man's arm a string, the end of which he dropped through the window into the yard. Then he told the police to watch the body secretly, while he pulled the string. They did so. When the boy gave the string a pull, the corpse's arm jerked. The cat imagined its master had revived. With one bound it sprang upon the bed, and furiously tore away at the corpse's wounded neck. Whereupon it was condemned to be burned alive, and the suspected persons were set free. It is believed that a cat's viciousness depends to a great degree upon the length of its tail. If the end of its tail be cut off, it is unable to take

part in the witch's *sabbat*. When a Walloon maiden wishes to refuse a suitor with contumely, she gives him a cat, and tells him to count its hairs. It is generally believed in France that a bachelor who treads on a cat's tail will find no woman to marry him till a full year has passed by. In Germany, in England, and in France many a religious *fête* of the middle ages culminated in pitching a cat off a height or into a bonfire. Indeed, as recently as 1818 a decree was issued at Ypres, in Flanders, forbidding the throwing of a cat off a high tower in commemoration of a Christian festival. Fontenelle told Moncrif that he had been brought up to believe that not a single cat could be found in town on the eve of St. John's, because they all went on that day to the witches' *sabbat*. It is readily intelligible from this why the people on that day threw into the fire all cats that were foolish enough to be caught. They actually believed that in doing so they were ridding the country of sorcerers.

— That the possibilities of agriculture in all parts and altitudes of Wyoming may be fairly tested, the trustees of the Agricultural Experiment Station of that State have established experiment farms in several different places. The west-central portion and the altitude of 5,500 feet above sea-level are represented by the Lander experiment farm of 137 acres, under irrigation, in Fremont County. The Laramie plains and the altitude of 7,000 feet are represented by the Wyoming University experiment farm of 640 acres, irrigated, in Albany County. The North Platte valley and the altitude of 6,000 feet are represented by the Saratoga experiment farm of 40 acres, Carbon County, irrigated. The northern part of the State and the altitude of 4,000 feet are represented by the Sheridan experiment farm of 50 acres, under irrigation, in Sheridan County. North-eastern Wyoming, with the greatest rain-fall and the altitude of 4,500 feet, is represented by the Sundance experiment farm of 49 acres, to be carried on without irrigation, in Crook County. South-eastern Wyoming, the Sybille valley, and the altitude of 5,000 feet, are represented by the Wheatland experiment farm, irrigated, in Laramie County. As the report of the Governor of Wyoming for 1889 shows that four-fifths of the State is between the altitudes of 4,000 and 8,000 feet, it is evident that the farming and grazing lands of Wyoming are now well represented. As soon, however, as the funds will permit, it is intended that other experiment farms will be established.

— Bulletin No. 14 of the Missouri Agricultural Experiment Station is devoted to a report on experiments with corn made in 1890. In these experiments a trial of deep and shallow tillage gave an increase of over fourteen bushels per acre, or twenty-one per cent of the entire yield, in favor of shallow tillage in 1889, and nearly thirteen bushels, or thirty per cent of the yield, in 1890. The implement used for shallow tillage was made expressly for this experiment, and has a number of knives running an inch or more under the surface, loosening the soil and effectually destroying weeds in its path, but not lifting the soil sufficiently to cover the weeds in the hill unless quite small. The Illinois Experiment Station at Champaign has made similar experiments, in which the average increase in favor of shallow culture was nearly eight bushels per acre over a period of three years. The Ohio Experiment Station has conducted similar experiments, using a cultivator not so well adapted to the purpose as the one described, but with results also in favor of shallow tillage. The Missouri bulletin, already quoted, also reports a series of experiments instituted for the purpose of determining the most profitable amount of culture for corn. The results of these experiments, and they are in harmony with similar tests made at the experiment stations of Illinois, New York, and Ohio, indicate that nothing is gained by cultivating incessantly. If the weeds are kept down and the ground is cultivated sufficiently to prevent a hard crust forming, two or three workings will produce as large a yield as half a dozen.

— Recent experiments in the laboratories of the Johns Hopkins University have shown that in one gram of loamy soil there are 3,740,000,000 particles. To the surface of each of these minute particles a thin film of moisture adheres by capillary attraction. The tips of the rootlets of plants have the power to absorb this hygroscopic water with the substances it holds in solution. The spaces between the particles of soil should be filled with air. If filled with water the plant will be killed by drowning. These experiments are of special interest in Wyoming, where soggy soil is rare, and the thickness of the film of moisture on the soil particle is the vital problem. Further experiments in the laboratories named have shown that certain alkalies have the power to thicken and retain the film of moisture on the soil particle. Experiments with these chemicals are being tried on the University experiment farm and grass fields of Wyoming, under the direction of Dice McLaren, in the hope of good results to the arid soils of that State. Gypsum and many other crystals have the property of absorbing and retaining vast amounts of moisture. It is probable that the rootlets of plants have the power to absorb this water of crystallization. Researches on this point are in progress at the station. Among the subjects used are ground gypsum and calcined gypsum. In moist climates gypsum is used as a reagent to set free the potash, nitrates, and phosphates in the soil. In the dry climate of the West gypsum may be found to have the further merit of absorbing water in wet times and of retaining it for the use of plants in dry times. In this connection experiments will be tried at the station with many native phosphates, nitrates, and other fertilizers, and with the waste products of glass and soda works.

— The other day, says *Nature* of May 28, Professor Vambéry delivered in Edinburgh, under the auspices of the Royal Scottish Geographical Society, an interesting lecture on British civilization and influences in Asia. He had many pleasant things to say about England, but did not quite overlook her shortcomings. He said he was immensely struck by the indifference shown by the public at large to every thing that concerned Asia. He had lectured in more than twenty towns in England, and found, even among the middle classes, great ignorance in regard to Asiatic geography and ethnography. Asiatic languages, moreover, were greatly neglected. Germany, which had not got any territory in Asia, bestowed far greater attention upon the old world than England. He opined that if the interest in Asia would increase in England commensurately with its political power and influence over the various races in Asia, Britain would decidedly remain there a permanent power which could never be ousted by any rival. He thought that there ought to be more schools for oriental languages in England. There was a general supposition that Britons in general could not learn foreign languages, but that was not true. The greatest linguists of our age had been British, as, example, Lord Strangford for Turkish, and the late Sir Richard Burton and the late Professor Palmer for Arabic. Then there were scholars like Sir James Redhouse, Sir Henry Rawlinson, Sir William White, and many others, bearing evidence of the brilliant linguistic capacity of the British. He believed that nothing could be easier than to recruit in England a goodly number of oriental linguists for employment in various Asiatic countries.

— In a communication to the New York *Sun*, not long since, Mr. George F. Kunz, the well-known expert in gems, called attention to a property of the diamond which may serve as a means of distinguishing it from other substances. Referring to the paper of Robert Boyle "On a Remarkable Diamond that Shines in the Dark," published in the "Transactions of the Royal Society" in 1663, Mr. Kunz remarks that this paper has been indirectly alluded to by a number of authors, but never read. Among a number of other facts, Boyle mentions one diamond that phosphoresced simply by the heat of the hand, absorbed light by being held near a candle, and emitted light on being rubbed. He stated that many diamonds emitted light by being rubbed in the dark. The experiments made by Mr. Kunz show conclusively not only that Boyle's statement that some diamonds phosphoresce in the dark after exposure to the sunlight or an arc electric light is true, but also that all diamonds emit light by rubbing them on wood, cloth, or metal, a property which will probably prove of great value in distinguishing between the diamond and other hard stones, as well as paste, none of which exhibit this phenomenon, and will be welcomed by the general public who do not possess the experience of the dealer in diamonds. The property is evidently not electric, or it would not be visible on being rubbed on metal.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

THE ACTUAL NUMBER OF TUBERCLE BACILLI WHICH MAY BE PRESENT IN TUBERCULOUS SPUTUM.

DR. GEORGE H. F. NUTTALL of Johns Hopkins University, in the last number of the "Johns Hopkins Hospital Bulletin,"[1] describes at length a method by which he has been able to make accurate estimates of the actual numbers of tubercle bacilli present in tuberculous sputum. His communication is accompanied by cuts of the apparatus used. The methods heretofore employed for estimating simply the relative number of tubercle bacilli in sputum are condemned as unscientific. Nuttall's observations for the first time give us an idea of the enormous number of tubercle bacilli which a patient may expectorate in the course of twenty-four hours.

In three cases undergoing the Koch treatment observations on the numbers of bacilli in the sputum were made every few days. In the first case the patient expectorated two billions of tubercle bacilli during the twenty-four hours; after the patient was inoculated with tuberculine the number of bacilli rose to three and four billions; after the inoculations ceased the number fell again to two billions.

In the second case the number of bacilli in the sputum varied between twenty and one hundred and sixty-five millions on the days preceding the Koch inoculations, rose irregularly to two hundred and eighty-three millions after the first inoculation, and fell to only two hundred and sixty-five thousand by the time the sixteenth inoculation had been reached. The third case showed a decrease from seventy millions before the inoculations to twelve and nineteen millions after treatment had commenced.

A great rise in the number of tubercle bacilli in sputum was observed in one case (which was not undergoing the Koch treatment) to occur simultaneously with the appearance of elastic tissue. The number of bacilli in this case rose from between three and four hundred millions to over four billions.

[1] A Method for the Estimation of the Actual Number of Tubercle Bacilli in Tuberculous Sputum. With a Note on the General Application of the Method to Bacteriology. By George H. F. Nuttall, M.D., Ph.D. (Göttingen). Reported before the Johns Hopkins Hospital Medical Society, April 6, 1891.

The accuracy of the method is shown by a number of control and culture experiments. Nuttall believes his method will prove valuable in any experiments where it is desirable to introduce a definite number of organisms into culture media, disinfectants, etc. In point of accuracy it far surpasses the loop method generally employed. With such organisms as the tubercle bacillus this method will enable the experimenter to determine the number he is inoculating into an animal in a way that has not been possible hitherto. Inoculations made under such conditions will clearly show the difference in degree of virulence possessed by various organisms, as also the relation between the number of bacteria introduced and the progress of the disease. This method finally brings us a step nearer to solving the problem of the significance of involution and degeneration forms of bacteria.

COLOR-PHOTOGRAPHY.

AT the reading of a paper on "Chromo Photography in Practice," by Leon Vidal, before a recent meeting of the Photographic Society of Great Britain, in London, a collection of photo-mechanical pictures in color was shown, from different countries, and made by different processes. According to the *British Journal of Photography*, the majority of the examples shown were far in advance of anything of the kind produced heretofore.

The journal mentioned goes on to say that the majority of the pictures are produced by methods analogous to ordinary chromo printing processes, inasmuch as different matrices are used for the different colors. The printing plates or stones being made more or less by the aid of photography, as an incentive to experiments in this direction, the journal indicates some of the methods by which prints in color may be obtained, and probably the ways by which the majority of those exhibited were made.

In 1876 M. Ducos Duhauron patented a method which he termed "photographs in colors." His method was to obtain three negatives of the subject, one by green light, another by yellow, and a third by violet light, by means of colored screens; aurine, eosine, and chlorophyl being employed as different color sensitizers. From the three negatives thus obtained prints were made on semi-transparent media, prepared with the complementary colors, and then superimposed on each other. The late Mr. W. B. Woodbury devised a process for producing prints in color. It was this. He made a Woodbury print on paper which had previously had the appropriate colors printed upon it by lithography. By this process Léon Vidal, some years ago, produced some excellent work, and evidently does so still, as proved by the specimens exhibited.

Another plan is to take three or more negatives of the same subject, and then stop out by hand in each certain portions representing the various colors, finally using these negatives to prepare printing plates or stones for successive printings, as in the case of chromo-lithography. By this system chromo-collotypes have long been made.

Messrs. Goupil & Co. have for some years past been producing photogravures in colors in one printing from a single plate. The method is this. The intaglio plate is inked in with different colored inks applied locally as required. This method is a somewhat tedious one, and necessarily requires considerable artistic skill on the part of the printer. Notwithstanding this, the firm have shown many excellent examples from time to time in the exhibitions of the Photographic Society. Instead of applying different colored inks on the same plate, it is obvious that separate intaglio plates can be prepared for the different colors and used for separate printings.

In his paper Léon Vidal alluded to the original method of superimposing a Woodburytype in monocrome on paper printed with suitable colors by lithography, and also treating similarly printed paper by imposing upon it a collotype print, as being the best in practice. He also expressed the opinion that the claims, which had been put forward by some, that the effects of nature could be obtained by the photographic selective character of the negatives

only, without the necessity of retouching or masking, could not be sustained.

One of the cheapest processes of chromo-photography is that of printing from half-tone relief blocks. Several examples by this method were shown in the exhibition. The blocks may be made from different negatives, representing the different colors, as in other processes; or they can all be made from a single negative, afterwards cutting away certain portions corresponding to the colors not required in that particular block.

THE EGG-PLANT.

THE egg-plant seems to have received little systematic attention, either from gardeners or students. Yet it is an important and interesting plant, and there are indications that it can be considerably modified by treatment. This is clearly shown by the results of studies and experiments made at the Cornell University Agricultural Experiment Station, by L. H. Bailey and W. H. Munson, and given in detail in Bulletin No. 26 of that station. Their studies of the egg-plant began five or six years ago, but three years were consumed in learning how to grow it. During the last two years they have grown all the varieties procurable in this country, in France, and in Japan.

The chief difficulty in growing the egg-plant in the North is the shortness of the seasons. It is only by starting plants early and maintaining a vigorous growth that the large sorts can be fruited satisfactorily. The plants should be started under glass from the middle of March to the middle of April in a warm house. The chief cause of failure during the early experiments was the lack of a good forcing house. In the cold and small house at the disposal of the experimenters the plants grew slowly, and when set out of doors they were not of sufficient size and vigor to begin bearing at once. The seed is sown in "flats" or boxes, and when the first true leaves are about half an inch in diameter — which is about a month after the seed is sown — the plants are pricked off into two-inch pots. As soon as the pots are filled with roots, the plants are shifted into four-inch pots. Indifferent success was met with in transplanting into other flats, as the plant is most severely checked when placed in the field, from the greater injury to the roots. It is imperative that the plants should not become "drawn." The plants are transferred from the four-inch pots to the garden from the first to the middle of June. The early sorts are not so seriously injured by a check in growth as the large and late sorts, and they can therefore be handled with less care. These sorts can be started two weeks later than the others and receive but one transplanting. The effects of early and late setting are shown in the following experiment.

Seeds of several varieties were sown March 27 and May 15. On the 7th of September they presented the following differences: long purple, giant round purple, and long white from early sowing were productive, but few or no fruits had formed on the plants from late sowing. Early long purple and round white from the late sowing were fully as productive as those from the early sowing. Early dwarf purple gave best results from plants started April 15. This shows that there is little or no gain in productiveness in the small early sorts from very early sowing, while the large sorts profit by it. The black Pekin, which is one of the large varieties, proved an apparent exception, however. Plants started May 1 gave better results than those started earlier, but neither lot was satisfactory. The unsatisfactory results from the early sowing may have been due to the loss of the first flowers because of the transplanting. Transplanting usually has the effect of keeping plants growing, to the detriment of the flowers; and egg-plants which are in bloom when removed to the field are apt to drop the flowers. It is important in the large sorts to induce the first flowers to set.

The best soil for egg-plants is a heavily manured rich sandy loam, — not too light, — which contains an abundance of humus and retains moisture. The large kinds were set three feet apart each way, although they can be set somewhat closer if land is very valuable. The ground should be thoroughly cultivated throughout the season. The patches were run through lightly with the cultivator at least twice a week.

The worst enemy of the egg-plant is the potato beetle, which prefers egg-plants to potatoes. The egg-plant grows slowly, and any injury to the young plant is overcome with difficulty, if at all. If the plants are seriously injured when first set out there will be little use in attempting to fruit them, especially the large kinds. Paris green, one pound to 100 gallons of water, is used for spraying.

It is rare that all the plants in a large plantation of the common or late varieties mature fruit, and such kinds as black Pekin, New York, and giant round purple rarely mature more than two large fruits to the plant in the latitude of the station, and often only one. The early dwarf purple, early long purple, and other early and medium varieties, mature from four to eight fruits without difficulty. The value of any of the late varieties depends very largely upon the uniformity with which all the plants in any lot set and mature fruit. The value of continuous and careful selection to this end was illustrated in the behavior of a large plantation of crosses last year, in which a large percentage of the plants were entirely unfruitful, showing that a promiscuous lot of seedlings is likely to be unproductive; and in this case these were crosses between productive parents. Breeding plants of uniform productiveness is the most important field in egg-plant experimentation at present.

The results of the experiments may be summed up as follows: (1) Egg-plants are adapted to cultivation in the North. The requisites of success in growing them are these: early starting; warm quarters; vigorous plants; rather late transplanting to the field; warm, rich, and rather moist soil; constant attention to potato beetles; frequent cultivation. (2) The best varieties for private use are early dwarf purple, early long purple, white Chinese, with perhaps black Pekin for late. (3) The best market varieties are New York improved and black Pekin, with perhaps early long purple for the first demands. (4) In crossing different races of egg-plants, the purple-fruited types appear to be stronger in their power to transmit color to offspring than do the white-fruited types; and this appears to hold whether the purple type is used as the staminate or the pistillate parent. (5) The white-fruited types appear stronger in the power to transmit form and productiveness. (6) Fewer seeds are produced by flowers artificially pollinated than by those left to mature, even though an excess of pollen is used. (7) It is probable that the egg-plant may be included among those plants which are capable of producing fruit without the aid of pollen.

As some of the neglect of the egg-plant is doubtless due to the fact that cooks are not familiar with it, the following recipes for cooking the fruits are recommended by the experimenters at Cornell as reliable. (1) Cut in slices crosswise, not over a half inch thick, and parboil in salt water about fifteen minutes; then remove, and fry in a hot spider in butter and lard. (2) Cut into slices a quarter or a half inch thick and lay in strong brine for two hours; then wash very thoroughly; sprinkle with brown sugar, pepper, and salt, and fry slowly to a dark brown. (3) Cut in two lengthwise, remove the seeds and pulp, and fill with dressing made of half a teacupful of bread crumbs, one teaspoonful of butter, and salt and pepper to taste; lay the halves side to side in a dripping pan, add a little water, and bake nearly an hour. (4) Pare, cut in thin slices crosswise, and soak in salt water for eight or ten hours; dry on a towel, dip in beaten egg, and roll in bread crumbs, then fry slowly in hot butter until the pieces become a rich brown; serve hot.

THE LOCUST PLAGUE IN ALGERIA.[1]

ON the 13th of May last I was travelling with my husband through eastern Algeria. At six o'clock on a lovely summer's morning we had taken the train from Algiers, making our way along the shores of one of the most beautiful bays in the world, its blue waters shining in the early sunlight beneath the wooded heights of Mustapha, studded with its white Arab villas. We had left behind us the Maison Carrée, where Cardinal Lavigérie's Pères Blancs make the best of both worlds in manufacturing excellent wines, and in preparing for their life of self-denial in the Sa-

[1] Evelyn Frances Bodley in the Contemporary Review for June, 1891.

hara. By nine o'clock we had reached Ménerville, where the fertile plain of Métidja ends, and the mountain country of the Kabyles begins. We were toiling up a steep ascent, when the order was given for all the passengers to alight. There had been a landslip, making the passage of a viaduct dangerous, so we had to get out and walk across it while the train cautiously followed us. Suddenly a cry was raised: "*Voilà, les sauterelles,*" and there before us, in the transparent air, looking like a summer snowstorm, we saw approaching a dancing cloud of winged particles. It was the advance guard of the dreaded locust army marching on Algiers.

For weeks nothing had been talked about in the neighborhood of my old home but "*les sauterelles.*" Everybody, French, English, or Arab, who owned a vineyard, or even a garden, was calculating the chances of the approach of the invading scourge, sometimes in a manner not intelligible to strangers. There was a lady not long arrived from England, whose knowledge of French was limited, and who asked me: "Who are these people, the Sauterelles, of whom every one is talking, but whom I have not yet met?" The day before starting on our journey I had been present at a wedding at one of the loveliest villas in Mustapha, to which the governor-general, Monsieur Jules Cambon, had come, on the very morrow of his arrival, to show his regard for his English friend, the bridegroom. When it was rumored that his excellency had accepted the invitation, all the well-informed declared that the new governor could not possibly be fulfilling social duties, when the locusts had appeared at St. Pierre-St. Paul, thirty-five kilometres distant from the capital. As a matter of fact, Monsieur Cambon, with the energy which characterizes that most amiable and distinguished Frenchman, after assisting at the wedding, set out, twenty-four hours later, on a tour of inspection of the ravaged districts, and I only mention this incident to show how the advance of the locusts was the sole absorbing topic of the hour in Algeria.

Here at last we were face to face with, or rather surrounded on all sides by, the devastating hordes. The railway crawls up the Kabyle hill country, through a succession of gorges, interrupted here and there by a tunnel, and sometimes the line skirts the cliff-side, hanging on a terraced ledge over a rushing river of the color of *café au lait.* The mountain defiles are thick with the flight of rushing insect life, but here in these barren passes there is nothing for them to prey upon, only a tuft of cactus here and there perched on the side of a torrent, or a solitary cluster of acanthus. But now the hills recede, and we are once more in the fruitful plains. How can I describe the glories of early summer in Algeria? English tourists come in the winter, and leave in the spring, taking away an impression of rare hours of sunshine, scattered among days of storm, and of scirocco, and sometimes, as this year, of snow; but it is in May that the full beauty of northern Africa comes forth in its wealth of flowers. We were now passing through a valley bounded by majestic snow-crowned heights, which appeared literally to be carpeted with a luxuriant growth of gorgeously tinted flowers — yellow marguerites, white and pink cistus, scarlet poppies, purple orchids, crimson gladiolus, and blue convolvulus — and sailing above this gay ribbon border of the fresh green of the vineyards, sped along the fluttering host of locusts, farther in all directions than the eye could reach. It seemed like a never-ending swarm of bees, bees as large indeed almost as skylarks, or at all events as humming-birds, but instead of bringing with it the proverbial luck of "a swarm of bees in May," it was carrying in its wake ruin and despair to the Mussulmans of the soil and their Christian conquerors.

It is popularly supposed that the locusts eat their way from place to place, and that the whole region through which a flight of them has passed is left devastated and bare. We saw no trace of the passage of the plague on our way, and, as a matter of fact, the locusts in their progress do comparatively little harm. The mischief is done when they settle and lay their eggs, which, when hatched, bring forth myriads of young — "*les criquets,*" and it is they which eat up the land. . . . It is difficult without seeming to exaggerate, to attempt any estimate of the countless myriads of *criquets* which are produced by the *sauterelles.* I will only mention one example, which may afford some idea of their numbers. In one commune alone during the last two months the weekly destruction of eggs has amounted to from eighteen to twenty millions.

Some years ago, when I was very little, I remember seeing a flight of locusts on the Mediterranean as we neared the coast of Algeria on the voyage from Marseilles. My childish recollection of it was that in the distance we saw a dense cloud approaching, and that when the ship passed through it, we seemed to be enveloped in a London fog for the space of several minutes. I have often thought that my young fancy had exaggerated the phenomenon, but though the swarms we passed through to-day were not densely packed, the numbers we encountered must have immeasurably exceeded the mass which I then saw flying across the sea from headland to headland. From Ménerville to Bouira is a distance of seventy kilomotres — between forty and fifty miles — yet never once was there a break in the procession. I had a reason for gazing attentively through the carriage windows. When I was seven years old I had driven by my father's side, in the days before railways were thought of in the Kabyle country, and as we approached the village at sunset, we saw a lion drinking at a stream. That is fourteen years ago, and it makes me feel a very ancient inhabitant of Algeria to think that I have seen, as a not extraordinary incident of a peaceful drive, a lion, which the most intrepid hunters have now to penetrate far into the heart of Africa to get a shot at.

After Bouira, as we approached the Department of Constantine, the locusts disappeared, and the next morning, in the picturesque capital of the eastern province, we could not find a line about the *sauterelles* in the curious little sheets, half a dozen of which do duty as journals in every town of Algeria. Nothing of greater interest was paragraphed than the visit of Admiral Duperré and the officers of the fleet from Philippeville to the old Roman fortress, and the complimentary remarks of Lieutenant Viaud (better known to the world as Pierre Loti) about the incomparable site of the rocky ramparts towering above the abysses of the Roumel.

A day later we went on to Hamman Meskroutine, where are the famous hot sulphur springs which rush steaming from the earth, forming cascades over petrified terraces of the dazzling whiteness of alabaster. Just as we were driving along the flower-bordered road which leads to this most beautiful sight, against a thunder-cloud which hung threateningly over the mountains, we espied between us and the dark background thousands of yellow flecks — they were our friends, the locusts, again. This lovely spot is in the midst of a vine country. Though the land was in full beauty, it was too late for tourists, and every one we saw there was connected more or less with the locality, from the Jewesses, in their grave mediæval costumes, come from Constantine or Tunis for the baths, to the small French proprietors, who sat round us at the *table-d'hôte;* and every tongue sounded the voice of lamentation at the appearance of the pest.

It was no passing cloud, as we realized the following morning, when we went on by train towards the frontier of Tunisia. The railway carriages of the Chemin de Fer de l'Est-Algérien are fitted with a little gallery which runs the length of the compartments, and very amusing it is to sit and watch the passengers lolling or promenading, especially as a large proportion of them are grave Arab chiefs, of charming manners and of splendid presence, in their graceful burnous. To-day the sons of the desert laid aside some of their dignified impassiveness, for no sooner had we started than we found ourselves among a host of locusts. It will hardly be credited when I say that far above the clatter of the train was heard the whirr of the countless wings. We passed through a mountain valley about a kilometre in width, and the whole expanse seemed blocked with the clamoring mob of insect life, and when the valley widened out into the fertile vine-clad plains that stretch around Guelma — where a generation ago Gérard, the renowned *tireur de lions* commenced his fame — as far as our sight could travel danced in the sunlight the yellow phalanx.

Algeria is so familiar to me, who have spent in that country nineteen out of my twenty-one winters, that I do not know if it be necessary to describe the geographical situation of the places I have mentioned, and of other localities ravaged by the locust plague. The three departments of Oran, Algiers, and Constantine, which compose the colony, stretch from Morocco on the west to Tunisia on the east, the city of Algiers standing about half-way

between the two boundaries, and the whole coast-line being about a thousand kilometres in length. The whole of this wide expanse is threatened by ruin, ruin compared to which the ravages of the phylloxera are mild. The last news which we had from the western province was that around Tlemçen, on the frontier, flights of locusts were alightihg unintermittently, and that a caravan just arrived there from Morocco had travelled for thirty-two days in the midst of locusts, the country being entirely devastated. I have said enough to show how the central department of Algiers is threatened, and now on the borders of Tunisia, advancing from the east, we had met once more with the dread hordes. The night before our arrival at Bône, the frontier port, a train coming thither from Tunis had been actually blocked for half an hour by a swarm at a little place called Oued-Zerga, and in the capital of the Beys the natives were trying to make the best of the plague by cooking and selling the *sauterelles* for food.

I have not the space, even if I had the technical knowledge, to describe the means by which Algerian cultivators are trying to stay the pest; how they set about the unpleasant work of destroying the eggs, and how, after incubation, they devise methods for stopping the march of the *criquets*, which, if unchecked, literally eat their way along, leaving the most verdant and fertile tracts a brown wilderness. Suffice it to say, that not only are the local authorities, the maires, and sous-préfets, organizing resistance and raising subsidies for the struggle, but, what is more significant in a territory which is above all things a military training-ground for France, the general commanding the forces in Algeria has granted a remission of thirteen days to all cultivators called to serve with the colors, whose properties are menaced by the locusts.

My last glimpse of the country, which I have the greatest reason for loving that a woman can have, was across the vineyards whose leafy lines stretch in never-ending vistas over the rich plains by the Tunisian frontier, and I thought of the sinister Arab prophecies which foretold that, after the conquest by the Franks of this fair land, an army of invaders, worse even than they, should come up from the desert, and extend the boundaries of the Sahara to the shores of the Mediterranean.

VARIETY AND PLANTING OF CORN.

BULLETIN No. 15 of the Pennsylvania Agricultural Experiment Station is a report of experiments on the influence of variety and the rate of seeding on the yield of ensilage corn. Two varieties of corn were planted, one the field corn ordinarily grown in that locality, the other Breck's Boston market ensilage, a large-growing variety which barely reaches the glazing stage before frost in that locality. Both varieties were sown in duplicate plots, of two rates of seeding each, the plots being alternated. The rows were three and a half feet apart, with guard rows between the plots, so that the ground was all equally occupied. Manure was applied liberally, but by a mistake the thick-seeded plots received larger quantities of manure as well as of seed. The thin-seeded plots were planted so that the stalks stood fourteen inches apart in the rows, while on the thick-seeded plots the stalks were three and a half inches apart.

The average yield of each pair of plots, calculated to one acre, was: small, thin-seeded, 11,962 pounds; small, thick-seeded, 19,013 pounds; large, thin-seeded, 20,955 pounds; large, thick-seeded, 26,840 pounds. It appears, therefore, that the larger variety gave a decidedly larger yield than the smaller one, and that thick seeding was decidedly more profitable than thin seeding.

Chemical analyses were made of samples from the various plots, from which it appeared that the produce of the larger variety and of the thicker seeding showed even greater superiority than that indicated by the gross yield.

Experiments similar to the foregoing have been conducted at the Ohio Experiment Station over several seasons, and these have uniformly showed a larger yield, both of grain and fodder, and therefore of food for animals, when the corn was so planted that the stalks stood about six inches apart in rows about three and a half feet apart, than when the distance between the stalks was greater. As between planting six inches apart and three inches apart, the Ohio experiments show better results from the six-inch planting.

Such close planting as this causes the ears to be chiefly nubbins, and therefore it is not to be recommended when merchantable grain is the product desired; but for silage purposes it is not necessary that the grain should be merchantable.

THE TRANSANDINE RAILWAY.

THE Transandine Railway now in process of construction across the Andes Mountains, for the purpose of connecting the railway systems of Chili and the Argentine Republic, is an enterprise involving many engineering difficulties. London *Engineering* has devoted considerable space to a series of illustrated articles on the railway and its construction, from which we gather the following facts.

The length of the new railway is 149 miles, of which 109 miles are on Argentine territory, starting from the city of Mendoza, which is 2,376 feet above the sea. In Chili there are forty miles, connecting with the Chilian system at Santa Rosa, 2,704 feet above sea-level. The greatest height attained by the railway is 10,460 feet above sea-level, the tunnel at that point being some two thousand feet below the summit of the mountains. There are eight tunnels grouped near the summit, aggregating 9.32 miles in length, the longest, the summit tunnel, having a length of 5,540 yards. To overcome a part of the difference in level within a short distance, and at suitable working gradients, it has been found necessary to construct a spiral tunnel 2,061 yards long, with a radius of 200 metres and a grade of eight feet in a hundred. It may be added that this grade is maintained through the whole nine miles of tunnelling, except, of course, in the summit tunnel.

It is in the boring of these tunnels that the greatest engineering difficulties are encountered. The absence of fuel, and the enormous expense of obtaining it, put steam out of the question as a motive power for driving the air compressors,—air-actuated drills being the means employed for boring the tunnels. Water power, the only other means available, was to be had, but at a considerable distance from the work. It was therefore decided to use the water-power for driving electro-dynamos, transmit the electric current by copper conductors to the sites selected for the compressors, convert it into power by means of electro-motors, thereby actuating the compressors and furnishing compressed air for the drills. The installations for this purpose are unique, as it is probably the first time that the power for compressing air for drills has been conveyed such a distance by electric cables. There are three installations, one upon the Argentine and two on the Chilian side of the Andes, each being distinct in all points, except that the primary stations on the Chilian side are both located at one place. Each installation has a primary station, where the turbines and dynamos are situated, and a secondary station, with electro-motors and air compressors.

The Chilian installation consists of two primary stations under one roof at Juncal, with secondary stations at Juncalillo and Calavera, and separate cables for transmitting the current. The power for driving the turbines is obtained from the Quebrada Juncalillo, the water being conveyed to the turbines, a distance of 1,420 yards, by a double line of steel pipes. The primary station at Juncal for the Juncalillo station consists of six Girard turbines, each giving 80 horse-power, a total of 480 horse-power. Each 80 horse-power turbine is coupled directly to the shaft of an 80 horse-power dynamo, consequently there will be no loss of power in transmission from the turbines to the dynamos. The latter are grouped in two groups of three dynamos each, each group having a main and return transmission cable. A great advantage is gained in having two groups, as should accidents or other cause prevent one from being worked, the whole of the tunnelling would not be stopped. At the secondary station at Juncalillo, about 3,281 yards from Juncal, the power available is 401.8 horse-power, cables being attached to six electric motors, similar to the 80 horse-power dynamos, which drive six air compressors.

The Juncal-Calavera installation is very similar to the one described above. The turbines are in the same shed, and take their water from the same source. These and the dynamos are also of

the same size and power, but since the distance from Juncal is 7,000 metres, against 3,000 metres for Juncal-Juncalillo, the power available at Calavera for driving the compressors is proportionately less, and only four compressors are driven.

In the Argentine installation the water-power is derived from the Quebrada Navarro, the water being conveyed to the turbines, a distance of 383 yards, by a single line of steel pipes. Owing to the difficulties of travel upon the Argentine side of the mountains, 80 horse-power dynamos were found to be too heavy for transport, and machines of half the power were therefore adopted. At the primary station at Navarro four Girard turbines of 80 horse-power each are used. Each turbine drives two 40 horse-power dynamos directly from its horizontal shaft, one on either side. The machines are in two groups, each of two turbines with four dynamos. One group can be worked independently of the other, should any accident arise, provided it does not affect the source of water supply. The 30 horse-power motors at Las Cuevas are similar to the dynamos at Navarro, and there is about 224 horse-power available for driving the compressors, which are of the same type as those for the Chilian installations. In the three installations, the air is conveyed from the compressors into large steel reservoirs, and from thence to the drills in wrought-iron pipes. The drills are mounted upon carriages, in groups of six, and are run forward on rails to the work.

The several stations are connected by telephone, so that, although the works are widely separated, the same initial power which is, by the various processes, converted into active work at the rock face, affords the means of instant and easy communication with all parts of the works. The workshops are lighted by electricity generated by a separate 10 horse-power dynamo.

THE EXPEDITIONS TO GREENLAND.

ON June 6 the whaling steamer Kite, which has been chartered for the purpose, left this port for Greenland, having on board two parties of explorers bent on adding to our knowledge of Greenland.

One of these parties is under the command of Lieutenant Peary, U.S.N., and is known as the North Greenland Expedition. Of their plans we give an account below. The other is known as the West Greenland Expedition, and consists of Professor A. Heilprin, the geologist, who will command; Professor Holt and Professor Benjamin Sharp, zoölogists; Professor W. E. Hughes, ornithologist; Dr. W. Burk, botanist; Dr. R. N. Keeley and Frazer Ashurst, surgeons; Professor L. W. Mengee, entomologist, and A. C. Kenealy. The West Greenland expedition will, after reaching Whale Sound on the Kite, proceed southward either to Upernavik or Disco Bay and finally to Godhaven, from which point the party will journey in the Kite to Ivigut and thence to St. Johns, Newfoundland. This section of the expedition expects to return about the middle of September.

The plans of the North Greenland Expedition are set forth in a letter from Lieut. Peary to the New York *Sun*, of which we give the following abstract: —

"My party will be landed in June or early in July at Whale Sound, latitude 77° 30′ north. The remainder of this season will be devoted to hunting for the winter's supply of meat, examining the features of the Whale Sound region, collecting natural objects, and more especially to reconnoissances of the inland ice in various directions. It is anticipated that one of these reconnoissances will be carried across the great tongue of the inland ice covering Prudhoe Land to the southern angle of Humboldt Glacier, and an advance depot for the main sledge journey established there. The winter will be occupied in making and fitting sledges, clothing, and all travelling equipment, and in snowshoe and skier practice, for which the level surface of Inglefield Gulf (head of Whale Sound) is especially adapted.

"Early next spring four of five of the party will start over the inland ice to Humboldt Glacier, with full sledges and dogs if practicable. Should favorable advance be made, this party will continue on from Humboldt Glacier to the head of Petermann Fjord. Here a second depot of supplies will be deposited, and from this point the advance party of two or three will push on with full sledges, the others returning to Whale Sound, to devote their tim during the absence of the main party to meteorological observa tions, collecting, and surveying. The main party will procee from the head of Petermann Fjord to the head of the Sherard Os borne Fjord, establish a depot there, thence to the head of D Long Fjord, establish a depot there, thence to the northern ter minus. This point reached and determined, the main party will retrace its steps to Whale Sound, taking up the various depots, and the entire party will then seize the first opportunity to come out.

"The salient features of the project are the smallness of the party and the utilization of the great interior ice plateau, the imperial highway of inner Greenland, as a road, instead of the sea of ice; and the whole theory of the project rests upon the now well-established fact that the interior of south and middle Greenland is covered with an uninterrupted ice cap, and the more than probability (in my opinion) that in north Greenland the conditions are the same, and the ice cap nearly, if not quite, coextensive with the land."

"My personal impression is that the northern terminus of Greenland is not north of the 85th parallel of latitude, and that the inner ice cap is practically co-extensive with the land; and this opinion is shared by Judge Daly and, I think, by most other eminent geographers. But whether this is the case, or whether Greenland extends as an Arctic continent across the pole, or is connected more or less loosely by detached masses of land with Franz Josef Land, or whether the ice cap ends at about the 82d parallel, as in Grinnell Land, I feel confident that in any contingency the efforts of my party will result in discoveries of interest, and, I hope, of considerable value to the scientific world. Should the Greenland ice cap terminate at or south of the 82d parallel, as Gen. Greely believes, I shall endeavor to follow its edge to the unknown east coast above Cape Bismarck.

"The especial advantages of my overland route over all others I regard to be as follows: the possibility of laying a straight course from point to point, with the certainty that no tidal crack or chaos of heaped-up ice will compel a long detour, or stop all further advance; that every foot travelled is a foot advanced, and the comforting assurance that nothing can happen to cut off the retreat; the even and unvarying character of the surface to be traversed, and the gain in lightness of sledges and equipment, and rapidity of advance resulting therefrom; the length of season (at least six months) during which sledging may be prosecuted; the facilities that the 'nunataks,' or island mountain-tops, which project above the 'inland ice' at distances varying from two or three to forty miles from the edge of the ice, offer for forming depots of provisions; and the exceptional value of the elevation of the route in accurately charting the coast and detecting the existence of more northerly land or lands."

"My base is the one advocated by Kane, Hayes, Hall, Judge Daly, and almost every American Arctic authority,— a region having a small and kindly native population, abounding in game, and within easy reach of the whalers which pass Cape York every year on their way to the fishing grounds in Lancaster Sound and adjacent waters. My proposed line of advance is absolutely direct throughout each stage. If it were not desirable to touch at the heads of Petermann, Sherard Osborne, and the other principal fjords which interrupt the northern coast, and determine their length and the characteristics of their heads, the line of march might follow very closely a great-circle course from the head of Whale Sound to beyond Lockwook's 'farthest.'

"As to the dangers and hardships of an eighteen months' sojourn above the 77th parallel, sentiment and imagination aside, I believe them to be no greater than they would be in northern Norway, Siberia, the higher Alps, or, to come nearer home, in Montana or Dakota in winter. It may be news to many to know that there are now in Greenland, under climatic conditions and environments similar to those of my proposed headquarters, Danish officers with their wives and families, living the same home life as the better classes here, with their window gardens, their music, their books, and all the other accessories of culture. I shall endeavor to collect all the scientific material and make all the observations practicable, but my first and last object will be the at-

tainment and determination of the northern terminus of Greenland, and everything will be subservient to that.

"I shall be accompanied by five young men, and the following particulars about the members of the party may be of interest. John M. Verhoeff of Louisville, Ky., is a young man of twenty-five, educated in an Eastern university, a mineralogist, and, though somewhat below the average in stature, has a magnificent lung development and a record for endurance and cross-country walking. Mr. Verhoeff has contributed generously to the expenses of the expedition. Dr. Frederick A. Cook, the surgeon of the expedition, is an able young physician and surgeon, a native of New York State, a graduate of the College of Physicians and Surgeons and of the University of the City of New York, and has been in practice in New York City for several years. He is twenty-six years old, strongly built, is five feet nine inches in height, weighs a hundred and fifty pounds, and has a lung expansion of five inches. Langdon Gibson of Flushing, L.I., is a stalwart young fellow of twenty-six, and one of the many active and enthusiastic members of the American Ornithologists' Union. He was one of the Brown-Stanton party in the memorable Colorado Cañon survey of 1889–90, and knows what arduous work is. He is six feet tall, weighs a hundred and seventy-eight pounds, and has an exceptionally fine lung development. Eivind Astrüp of Christiania, Norway, is a stalwart young fellow, who has but recently come to this country. He is the son of the commander of the Royal Civil Guard of Christiania, a first-class graduate of the Christiana Commercial College, and a winner of numerous prizes in athletic sports, especially ski-running. He is five feet seven inches in height, weighs a hundred and sixty-seven pounds, and has a lung expansion of four inches. Matthew Henson is a hardy young colored man, a native of Virginia, twenty-three years old. His intelligence and faithfulness, combined with more than average pluck and endurance, as shown during several years that he has been with me through varying experiences, part of the time in Nicaraguan jungles, lead me to regard him as a valuable member of the party. The members of my party are all young, and, in addition to possessing first-class physique and perfect health, they are men of education and attainments. I believe this to be the type of man best fitted to endure with minimum effect the ordeal of the Arctic winter, and to effectively execute a two or three months' dash on sledges, where intelligent will-power, elasticity, and enthusiasm are at a premium over the stolid endurance of muscles hardened by years of work. Mrs. Peary will accompany the party to Whale Sound. Possessed of youth, health, energy, and enthusiastic interest in the work, she sees no reason why she cannot endure conditions and environment similar to those in which Danish wives in Greenland pass years of their life. In this opinion I fully concur, and believe that in many ways her presence and assistance will contribute to the valuable results of the expedition, as they have been invaluable to me in the preparation.

"The food supply of the party is not materially different from that of the later Arctic expeditions. Tea, coffee, sugar, and milk are in quantity sufficient to last two and a half years; other supplies for a year and a half. But little meat will be taken, outside of the pemmican for the sledge journey, as there is an abundance of reindeer, ptarmigan, Arctic hares, foxes, ducks, loons, seals, and walrus in and about Whale Sound. Special items of interest, principally for the sledge journey, are as follows: tea, compressed into quarter-pound cakes, partially divided, like chocolate, into quarter-ounce squares; compressed pea soup tablets, a German preparation; beef-meal pemmican and beef-meal and cocoa tablets, prepared expressly for the expedition; evaporated cabbage, potatoes, onions, turnips, carrots, and apples.

"Next to the food supply comes the house. This will be a light structure twelve by twenty feet (inside measurement) with double walls inclosing a ten-inch air space. There will be a triangular air space between the ceiling of the rooms and the roof sheathing, and the rooms will have three layers of tarred paper between them and the exterior air. The walls of the rooms will be hung at first with blankets, and later probably with skins. The house will be surrounded by a wall of stones, turf, and snow as high as the eaves, leaving a narrow passage entirely around the house, and during the winter this space and the roof of the house itself will covered in with a thick layer of snow.

"The expedition will have two whale boats and several sledges, including the two made and used by me in Greenland in 1886. The new ones, though of the same type, will be lighter than the old ones. Each member of the party will have Indian snowshoes and Norwegian "ski" moccasins and rubber ice creepers."

LETTERS TO THE EDITOR.

**** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

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Immortality in the Light of Modern Dynamics.

I WOULD like, with your permission, to take issue with the writer of the article under the above title published in *Science* of May 29.

The eleventh paragraph, speaking of the reader of the journal of the Institute having "read the same lines" therein, "an endless number of times," "billions of years ago," naturally suggests doubts of his seriousness; and if I am mistaken in the assumption that a gentleman of his great attainments and high position is surely in earnest while thus treating on scientific subjects before that learned body, the Franklin Institute, and that therefore the paper could not have been intended as a burlesque upon modern science, it must be set down to my "simplicity."

In his illustration by the falling of dice, he truly says that the number of dice used has nothing to do with the truth of the proposition that they must, some time, again present — and with a certain average frequency — the same combination of numbers. Evidently, however, he quite overlooks one element of the case, which omission — a most astonishing one — utterly vitiates his illustration and reasoning thereon.

The matter overlooked is the fact that each one of the dice is limited to a certain finite number of exact positions, in one of which it must fall; and after it has, once or more, fallen in each of these, all subsequent falls must necessarily be exact repetitions of some of these, hence the possible number of combinations is also limited, and then must come repetitions.

Let us suppose, however, that the dice, instead of cubes, be perfect spheres, and thrown upon a perfect plane. The number of positions in which any one could come to rest would be infinite, and it is scarcely supposable that it would ever, in an eternity of throws, take absolutely the same position a second time. Now, such is the condition of the atoms spoken of, except that in their case it is more complex, as their are more conditions.

Every particular combination produced must, of course, be simply the resultant of the positions and motions of the atoms. The possible positions and also the possible directions of motion, as well as velocities, are infinite in number, hence the chances are infinity to one against the same combination again occurring even between any two of them, — yea, an infinity of infinities.

Moreover, when the same concurrence of the atoms should occur and reconstruct the same identical form, — of Cæsar, for example, — an essential pre-requisite is, that all influences must be the same as before, hence all surrounding conditions, near or remote, must be identical with those of the former epoch; i.e., the universe must be throughout exactly as before: there are no influences except position and motion, hence every identical atom must be, at the one instant, in the same one of the infinitively various positions, moving at the same one of the infinite different velocities, and in the same one of the infinitely different directions, including the infinite various vibrations, as before, — all this while it is incredible that any one of them will ever move in absolutely the same direction a second time, or that any one of the conditions requisite to the repetition of a former combination will ever exist.

An infinitesimal difference from the former time in the case of any one atom in the universe in any particular at that instant

must affect the next contiguous one, and so on *ad infinitum*, and change the result.

So, taking his illustration of the action of sand grains, not one of them is bound, nor are they likely ever, in an eternity of shaking, to take again the identical position that they have once assumed, because there is not supposed or suggested any cause guiding them to it. There is an infinite number of other positions equally possible and likely,—an infinite number can never be exhausted. And, further, sand grains or atoms have not, like the dice, one fixed plane on which they must rest: the number of planes which they may occupy is unlimited.

In his dice illustration he limited the repetition to the one circumstance of numbers uppermost; whereas, had he taken into account lateral position and distance apart,—all of which, and much more, he must do before he is fully prepared for the rehabilitation of Julius Cæsar in his ancient glory,—his reasoning would not apply, even to the dice.

The former exact position or motion of an atom can have no influence to cause it to be repeated, hence all — conceivable or inconceivable — combinations must be equally possible, equally probable, equally certain; where then is the suggested improbability that the molecules constituting the author's body "once filled a bung-hole," or, indeed, not once only, but an infinite number of times? Some atoms had to fill it, why not those? This point needs elucidation, or we must hold that, according to his "iron logic of modern dynamics,"— which he seems for the moment to have lost sight of,— these very atoms must take their turn at the bung-hole from time to time, as well as the rest.

The great Solomon, the wisest man that ever lived or ever shall live, erred for once in his oft-quoted doctrine, "There is nothing new under the sun," inasmuch as he should have said, "There is nothing *old* under the sun;" i.e., no combination of things, circumstances, or conditions which ever — precisely — occurred before, or which is absolutely identical with those at any preceding epoch. "The thing that hath been is [not exactly] that which shall be."

Hence it plainly appears that the recurrence of the same entire range of conditions, which, to the minutest particular and throughout the universe, is requisite to the reproduction of former structures and actions, is as certain never to take place, as is the same epoch, the identical moment of time, certain never to return.

W. H. PRATT.

Minneapolis, Minn., June 5.

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dissertations in political science." The opening number of the series is a paper on "The Divorce Problem," by Walter F. Willcox, and is in the main a compilation of statistical matter taken from the report on divorce made by Carroll D. Wright of the Labor Bureau. Various remarks by the author are interspersed, and at the close he considers briefly the causes that have made divorce so common in this country, and offers a few suggestions as to the remedy. Most of his remarks are sensible, but there is nothing new in them, and those who know what has been written on the subject by others will get no particular help from Mr. Willcox. The style of the pamphlet is similar to that of most other college publications, and indicates that the study of literature in the colleges is not what it should be.

"The Evolution of Wool Spinning and Weaving" will be described by S. N. D. North in the July *Popular Science Monthly*. This is the sixth paper in that periodical's illustrated series on the development of American industries since Columbus, and covers a notably interesting group of inventive labors. Under the title of "Man and the Glacial Period," Professor G. Frederick Wright will contribute to the same number a record of the important facts that have come to light in the last two years bearing upon the connection of man with the ice age in North America. The paper will be illustrated. "Sanitary Improvement in New York during the Last Quarter of a Century," by Gen. Emmons Clark, who has been secretary of the New York Board of Health during the whole twenty-five years that it has been in existence; "Pollen: its Development and Use," by Professor Joseph F. James; "Colors of Letters," by David Starr Jordan, the newly appointed president of Stanford University; and an account of "Our Agricultural Experiment Stations," by Professor Charles L. Parsons, will add to the completeness of the number.

— *The Home Journal*, in its issue of June 10, publishes a double number, consisting of sixteen large pages. The paper includes, besides its usual literary features, a "Summer Resort Guide."

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